241. HIGH TEMPERATURE, OPTICAL SAPPHIRE PRESSURE SENSORS FOR HYPERSONIC VEHICLES

PROJECT AT-A-GLANCE

- **AST RDAB POC:** Demidovich, Nick
- **AST RESEARCH AREA:** 2.2 Vehicle Safety - Technologies
- **PRINCIPAL INVESTIGATOR:** Mark Sheplak, William S. Oates
- **EXECUTION ENTITY:** UF, FSU
- **PERIOD OF PERFORMANCE:**
- **STATUS:** Ongoing

PROJECT DESCRIPTION

PURPOSE: The study of hypersonic boundary layers is critical to the efficient design of hypersonic vehicles for rapid global and space access. The harsh environment makes conventional instrumentation unsuitable for time accurate, continuous, direct measurements. The development of a high temperature sensor for direct measurement of pressure is vital to the understanding of shock-wave/boundary layer interactions which directly influence critical vehicle characteristics such as lift, drag, and propulsion efficiency.

OBJECTIVES: - Design a sapphire optical lever microphone via multiphysics analytical modeling - Develop thermocompression fabrication methods for the formation of devices with moving parts out of sapphire and platinum

- Development of techniques for ultrafast laser micromachining of sapphire for sensor and packaging fabrication

- Fabrication and packaging of pressure sensors optimized for low-noise and high-sensitivity while possessing minimal drift associated with changes in relative humidity, temperature, etc.

- Characterization of sensors in a simulated, high temperature, pressurized laboratory environment

- Implementation in a hypersonic flow facility (such as Arnold Engineering Development Center, etc.) and/or a gas turbine (such as the Capstone C60 microturbine at the University of Florida, etc.)

GOALS: Design a fiber optic lever pressure sensor with a remote photo-diode optical readout. The microphone is composed of a compliant, platinum coated, sapphire diaphragm bonded over a cavity containing a single optical fiber. The diaphragm deflection is detected via intensity modulation due to the motion of the reflective platinum coated sapphire diaphragm. The optical signal is routed via the high temperature sapphire fiber to a remote photo-diode allowing for insulation of the electronics from the harsh environment.